



Vulture Products - Material Properties

Product Layers

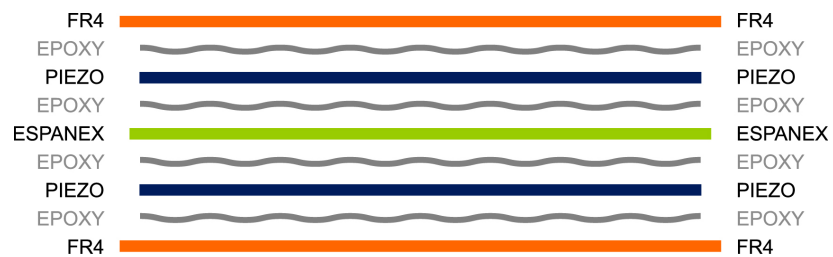


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Typical Engineering Values

Property / Condition	Value (U.S. Units)		Value (Metric Units)		Test Method
Mechanical					
Peel Strength - 1 oz. (35μm) Cu					
After Solder Float	9.0	lb/inch.	1.58	N/mm	IPC-TM-650.2.4.8
At Elevated Temperature	7.0	lb/inch	1.23	N/mm	IPC-TM-650.2.4.8.2a
After Exposure to Process Solutions	9.0	lb/inch	1.58	N/mm	IPC-TM-650.2.4.8
X/Y CTE [-40°C to +125°C]	12 - 16	ppm/°C	12 - 16	ppm/°C	IPC-TM-650.2.4.41
Z Axis Expansion [50°C to 260°C]	4.5	%	4.5	%	IPC-TM-650.2.4.41
Young's Modulus (X/Y)	4.1/3.5	psi x 10 ⁶	24.8/23.4	GN/m ²	ASTM D3039
Poisson's Ratios (X/Y)	0.16/0.14		0.16/0.14		ASTM D3039
Thermal Conductivity	0.3 - 0.4	W/mK	0.3 - 0.4	W/mK	ASTM E1461-92
Specific Heat	1.2 - 1.4	J/gK	1.2 - 1.4	J/gK	ASTM E1461-92
Electrical					
Dielectric Constant (50% resin content)					
@ 1 MHz (TFC/LCR Meter)	4.4		4.4		IPC-TM-650.2.5.5.3
@ 1 GHz (RF Impedance)	4.1		4.1		IPC-TM-650.2.5.5.9
Dissipation Factor (50% resin content)					
@ 1 MHz (TFC/LCR Meter)	0.027		0.027		IPC-TM-650.2.5.5.3
@ 1 GHz (RF Impedance)	TBD		TBD		IPC-TM-650.2.5.5.9
Volume Resistivity					
C - 96/35/90	10 ⁸	MΩ - cm	10 ⁸	MΩ - cm	IPC-TM-650.2.5.17.1
E - 24/125	10 ⁷	MΩ - cm	10 ⁷	MΩ - cm	IPC-TM-650.2.5.17.1
Surface Resistivity					
C - 96/35/90	10 ⁷	MΩ	10 ⁷	MΩ	IPC-TM-650.2.5.17.1
E - 24/125	10 ⁷	MΩ	10 ⁷	MΩ	IPC-TM-650.2.5.17.1
Electric Strength	1250	V/mil	4.9x10 ⁴	V/mm	IPC-TM-650.2.5.6.2
Dielectric Breakdown	>50	kV	>50	kV	IPC-TM-650.2.5.6
Arc Resistance	65	seconds	65	seconds	IPC-TM-650.2.5.1
Thermal					
Glass Transition Temperature (T _g)					
DSC (°C)	140	°C	140	°C	IPC-TM-650.2.4.25c
TMA (°C)	130	°C	130	°C	IPC-TM-650.2.4.24c
Degradation Temp (TGA) (5% wt. loss)	300	°C	300	°C	IPC-TM-650.2.3.40
Pressure Cooker - 2 hour					IPC-TM-650.2.6.16
10 second solder dip @ 288°C	Pass		Pass		(modified)
T ₂₆₀	8 - 12	minutes	8 - 12	minutes	IPC-TM-650.2.4.24.1
Chemical / Physical					
Moisture Absorption	0.1	wt. %	0.1	wt. %	IPC-TM-650.2.6.2c
Methylene Chloride Resistance	0.7	% wt. chg.	0.7	% wt. chg.	IPC-TM-650.2.3.4.3
Density [50% resin content]	1.92	g/cm ³	1.92	g/cm ³	Internal Method

Note: All test data provided are typical values and not intended to be specification values. For review of critical specification tolerances, please contact a Park/Nelco representative directly. Park/Nelco reserves the right to change these typical values as a natural process of refining our testing equipment and techniques.

Description

Redux 312 is a high-strength 250°F curing film adhesive, suitable for metal to metal bonding and sandwich constructions, where operating temperatures of up to 210°F may be experienced.

A supported version, Redux 312/5, is available with a woven nylon carrier for bond line thickness control.

Features

- Short cure cycle - cures in 30 minutes at 250°F
- Good mechanical performance up to 210°F
- Suitable for composite to composite bonding
- Low volatile content (solventless process)

Applications

- Metal to metal bonding
- Sandwich constructions
- Composite to composite bonding

Forms

Gray flexible film adhesive, available in 5 areal weights; 4 in unsupported form and one with a woven nylon carrier.

Product Description	Areal Weights psf	Roll Width in	Standard Roll ft ₂
Redux 312	0.015	21	645
Redux 312UL	0.02	21	645
Redux 312L	0.03	21	645
Redux 312	0.06	21	645
Redux 312/5	0.06	21	645

Instructions For Use

Pretreatment

It is essential that all substrates to be used are free of contamination and are in as ideal a state for bonding as possible. As pretreatment varies significantly depending on the substrates used, please refer to the Hexcel Composites publication, Redux Bonding Technology, for optimum procedures.

If there is to be a delay between the pretreatment and bonding of aluminum, the pretreated surface should be protected with Redux 112 or Redux 140 surface pretreatment protection solution to conserve the optimum bonding surface. This will enable bonding to be delayed for up to 2 weeks without deterioration of the pretreated surface. The correct application of Redux 112 or Redux 140 should not alter the bonding performance of Redux 312 (for full application details consult the relevant data sheet).

Application

1. Allow sufficient time for the adhesive to warm to room temperature (65°F - 80°F) before removing the protective polyethylene.
2. Cut the film to the shape and size required.
3. Remove the release paper and position the adhesive on the prepared bonding surface.

- Remove the polyethylene backing sheet.
- Complete the joint assembly and apply pressure while the adhesive is being cured. For sandwich structures the pressure application should be selected to suit the type of core used. After the adhesive has cured it is advisable to maintain pressure on the bonded assembly until it has cooled sufficiently to be handled without discomfort.

Curing

Redux 312 should be cured at $250 \pm 5^{\circ}\text{F}$ for 30 minutes to obtain optimum properties. Enough time should be allowed for heat to penetrate through the assembled parts to ensure that the adhesive reaches that temperature before timing starts. Cure pressures of around 25-50 psi and heat up rates of approximately 5°F per minute are recommended during cure. After curing it is recommended that components are cooled to below 150°F before releasing the pressure.

Mechanical Properties

All the performance values given in this data sheet are based on experimental results obtained during testing under laboratory conditions. They are typical values expected for Redux 312 prepared and cured as recommended and under the conditions indicated. They do not and should not constitute specification minima.

Metal Bonding Strengths

Redux 312 at areal weights of 0.015, 0.02, 0.03 and 0.06 psf, and Redux 312/5 at areal weight 0.06 psf, were used to bond Alclad 2024-T3 aluminum test specimens; the aluminum was pretreated in accordance with DTD 915B (ii) (chromic/sulphuric acid pickling). The honeycomb tests used Hexcel's 7.9-1/4-40 (5052) T aluminum honeycomb.

Test	Test Temperature °F	Redux 312 0.015 psf	Redux 312 0.02 psf	Redux 312 0.03 psf	Redux 312 0.06 psf	Redux 312/5 0.06 psf
Lap Shear Strength psi	70	5400	5700	6000	6200	5510
	160	4800	4600	5500	5700	4300
	175	4600	4600	5100		
	210			2500	4300	
Bell Peel lbs/in	70		52	55	52	55
Climbing Drum Peel in-lb/3in	70		22	39	80	57
Flatwise Tensile psi	70		800	1020	1320	1250

Storage

Redux 312 has been formulated for maximum storage life consistent with its high performance. Certain precautions, however, will help to enhance that storage life as follows:

- When stored at room temperature (less than 80°F) it should be kept on a horizontal mandrel passed through the tube core on which the roll is wound. This avoids the risk of local thinning of the film under the weight of the roll.
- When storing under refrigeration the original packaging should be retained if possible. When returning to the refrigerator after use it is essential to protect the film with a water vapor barrier packaging material such as polyethylene.

3. On withdrawal from the refrigerator the water vapor barrier packaging should not be removed until the roll of adhesive has reached room temperature. This may take up to 24 hours depending on the size of the roll and the temperature involved (failure to observe this will result in the film becoming damp).
4. The film should be handled with care while in the frozen state since it will be brittle and easily cracked. On receipt, Redux 312 will have a storage life of at least 12 months at 0°F plus an additional shop life of 1 month at below 80°F.

Volatile content

Redux 312 has a very low volatile content, usually well below 1%. In practice, the loss in weight when cured is negligible and emission of volatile products is not of practical significance.

Associated products

Redux 112 and Redux 140 surface pretreatment protection solutions (primer) Redux 212/NA and 206/NA foaming film adhesives

Handling and safety precautions

In common with all Redux adhesives in film form, Redux 312 is particularly free from handling hazards for the following reasons:

- Film is covered on both sides by protective release paper and polyethylene sheet which are not removed until final component assembly. It should be cut to shape before removing the protective coverings and virtually no handling of the film is necessary.
- Virtually tack-free (dry) at normal room temperature. The film is dependent on elevated temperature for wetting-out the adherent surfaces.
- Volatile-free at normal room temperature.
- Splash-free, leak-free, spillage-free.

However, the usual precautions necessary when handling synthetic resins should be observed. A Material Safety Data Sheet for Redux 312 is available on request.

Release Certification

The Quality System at Hexcel Composites Duxford has been certified to ISO 9001 by Lloyd's Register Quality Assurance, and is approved by the UK Civil Aviation Authority and Ministry of Defence. Certificates of Conformity and Test Reports can be issued for batches of Redux 312 on request.

Important

Hexcel Corporation makes no warranty, whether expressed or implied, including warranties or merchantability or of fitness for a particular purpose. Under no circumstances shall Hexcel Corporation be liable for incidental, consequential, or other damages arising out of a claim from alleged negligence, breach of warranty, strict liability or any other theory, through the use or handling of this product or the inability to use the product. The sole liability of Hexcel Corporation for any claims arising out of the manufacture, use, or sale of its products shall be for the replacement of the quantity of this product which has proven to not substantially comply with the data presented in this bulletin. Users should make their own assessment of the suitability of any product for the purposes required. The above supercedes any provision in your company's form, letters, or other documents.

Piezo Material Properties

Following are the available piezoelectric properties for the specific type of piezoceramic used in the standard QuickPack® strain actuators. Please consult Midé for properties of custom QuickPack® devices.

Property	Symbol	Unit	CTS - 3195HD
No of days after poling			
Electrical - Low Field			
Relative Permittivity	$\epsilon_r^T_{33}$		1700
	$\epsilon_r^S_{33}$		830
Relative Permittivity	$\epsilon_r^T_{11}$		1730
	$\epsilon_r^S_{11}$		916
Dielectric Loss	Tan δ		0.02
Resistivity (at 25o)	ρ_{el}	Ωm	
Resistivity (at 100o)	ρ_{el}	Ωm	
Resistivity (at 200o)	ρ_{el}	Ωm	
Electrical - High Field			
Increase in $\epsilon_r^T_{33}$ @ 2KV/cm		%	
Dielectric Loss @ 2KV/cm	Tan δ		
Increase in $\epsilon_r^T_{33}$ @ 4KV/cm		%	
Dielectric Loss @ 4KV/cm	Tan δ		
Remanent Polarization	P_r	$\mu\text{Coul}/\text{cm}^2$	39
Electro-Mechanical			
Coupling Factors	k_p		0.65
	k_{15}		0.59
	k_{31}		0.36
	k_{33}		0.72
	k_{13}		0.715
	k_t		0.48
Dielectric Constant (1kHz)	K^T_3		1900
Charge Constants	d_{33}	$\times 10^{-12} \text{ C/N}$	390
or Strain Constants	d_{31}	$\times 10^{-12} \text{ C/N or m/V}$	-190
	d_h	$\times 10^{-12} \text{ C/N}$	32
	d_{15}	$\times 10^{-12} \text{ C/N or m/V}$	584.5
Voltage Constants	g_{33}	$\times 10^{-3} \text{ Vm/N}$	24
or Stress Constants	g_{31}	$\times 10^{-3} \text{ Vm/N}$	-11.3
	g_h	$\times 10^{-3} \text{ Vm/N}$	2
	g_{15}	$\times 10^{-3} \text{ Vm/N}$	38.2
	$d_h g_h$	$\times 10^{-15}$	64

Property	Symbol	Unit	CTS - 3195HD
Frequency Constants Radial	N_r	Hz.m	2020
Resonant Thickness	N_{tr}	Hz.m	2110
Anti-Resonant Thickness	N_{ta}	Hz.m	2360
Frequency Constants	N_p	Hz.m	1960
	N_1	Hz.m	1400
	N_3	Hz.m	1770
	N_5	Hz.m	
	N_a	Hz.m	1845
	N_{3t} or N_{33}	Hz.m	1880
	N_s	Hz.m	
	Hoop or N_c	Hz.m	890
	N_t	Hz.m	
Compressive Strength		10^6 Pa	
Tensile Strength		10^6 Pa	
Quality Factor	Q_m		80
Coersive Field (<1Hz)	E_c	KV/cm	12
Mechanical			
Compliances			
	S_{33}^E	x $10e-12$ m ² /N	18.8
	S_{11}^E	x $10e-12$ m ² /N	16.4
	S_{12}^E	x $10e-12$ m ² /N	-5.74
	S_{13}^E	x $10e-12$ m ² /N	-7.22
	S_{44}^E	x $10e-12$ m ² /N	47.5
	S_{55}^E	x $10e-12$ m ² /N	44.3
	S_{66}^E	x $10e-12$ m ² /N	44.3
	S_{33}^D	x $10e-12$ m ² /N	9.43
	S_{11}^D	x $10e-12$ m ² /N	14.4
	S_{12}^D	x $10e-12$ m ² /N	-4.24
	S_{13}^D	x $10e-12$ m ² /N	-2.98
	S_{44}^D		25.2
	Y_{11}^E	x $10e10$ N/m ²	6.7
	Y_{33}^E	x $10e10$ N/m ²	5.3
	Y_{11}^D	x $10e10$ N/m ²	10.6
	Y_{33}^D	x $10e10$ N/m ²	6.9
Poisson's Ratio σ			
Density	ρ	kg/m ³	7800
	Q_c		75
	Q_e		50
Thermal Data			
Curie Temperature	T_c	°C	350

Property	Symbol	Unit	CTS - 3195HD
Approx. Operating Temp.		°C	250
Specific Heat		J/kg K	
Thermal Conductivity		W/m K	
Young's Modulus	E	Gpa	
Internal Friction	Q^{-1}	$\times 10^{-4}$	
Time Stability			
Coupling Factor	k_p	Relative change per time decade %	0
Permittivity	ϵ_{33}^T		-0.9
Frequency	f		0.1
	d_{33}		-2.9
Time Constant	$\rho\epsilon T/33$ (25oC)	minutes	
Dielectric Loss Factor (1kHz)	Tan δ	%	1.8

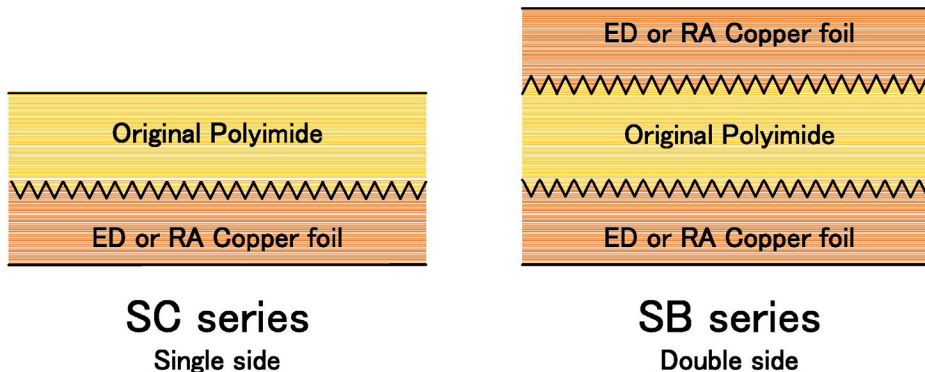
Adhesiveless, Flexible Copper Clad
Polyimide Laminate
Single side

ESPANEX[®] SC series

Adhesiveless, Flexible Copper Clad
Polyimide Laminate
Double side

ESPANEX[®] SB series

ESPANEX SC & SB series: are single and double sided copper clad, flexible adhesiveless polyimide dielectric laminates used for Flex circuitry, Flex-rigid multilayers, and TBGA chip carrier packaging. These high performance flexible laminates are based upon engineered polyimide chemistries that result in CTE's matched to copper foils combined with high Tg thermal resistance. Excellent dimensional stability and high service temperature provide designers with flexible interconnects for fine pitch high density applications.

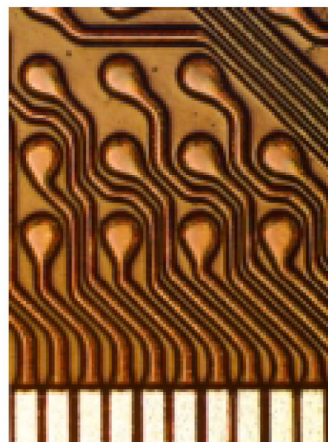


■ Features

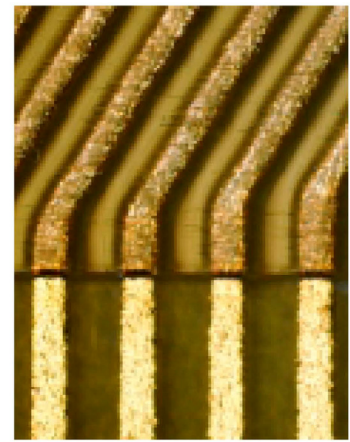
- Excellent **dimensional stability** related to our unique casting technology.
- Excellent **heat/thermal resistance** for wire bonding, soldering and high temperature applications.
- Excellent **chemical resistance** to processing and plating chemistries.
- **Multiple Copper foil selections**, ED/RA, thickness and treatment profiles.
- Excellent **electrical performance** related to additive free polyimide dielectric.
- Excellent performance using **laser processing** for micro via designs.

■ Application

- Flex circuits
- Multilayer Rigid-Flex wiring boards
- Chip On Film substrate
(Chip on Flex)
- CSP & BGA
- PDP driver
- etc.



Example 1, CSP



Example 2, COF

■ Copper Foil Types & Polyimide Thickness Selection

● Copper foil selections

ESPANEX SC & SB series adhesiveless copper clad laminates are produced by our precision polyimide CASTING process, using NSCC developed polyimide precursor chemistry cast onto specified copper foils. Copper foil types and thickness may be selected according to the design requirements of each application.

Process	Supplier	Supplier's grade	NSCC grade	
			Single side	Double side
ED: Electro deposit	Mitsui Mining & Smelting	3EC-III	SCXX-YY-00ME	SBXX-YY-XXME
		SQ-VLP	SCXX-YY-00AE	SBXX-YY-XXAE
	Nippon Den kai	SLP	SCXX-YY-00WE	SBXX-YY-XXWE
		USLP	SCXX-YY-00KE	SBXX-YY-XXKE
	Circuit foil Japan (Furukawa)	WS	SCXX-YY-00CE	SBXX-YY-XXCE
RA: Roll annealed	Japan Energy	BHY	SCXX-YY-00FR	SBXX-YY-XXFR

XX=Copper foil thickness, YY=Polyimide thickness

● Polyimide thickness

Our CASTING process can provide polyimide thickness of 12μm, 25μm, 40μm and 50μm for single sided and 25μm and 50μm for double sided.

Polyimide thickness	NSCC grade	
	Single side	Double side
12μm	SCXX-12-00ZZ	
25μm	SCXX-25-00ZZ	SBXX-25-XXZZ
40μm	SCXX-40-00ZZ	
50μm	SCXX-50-00ZZ	SBXX-50-XXZZ

XX=Copper foil thickness, ZZ=Copper foil type

■ General Properties

Property		Units	SC18-25-00		SB18-25-18		Test method
			FR	WE	FR	WE	
Tensile Strength		MPa	249.7		242.2		IPC-TM-650, 2.4.19
Tensile Elongation		%	49.3		55.5		
Tensile Modulus		MPa	4500		4500		
Peel Strength	Initial	kN/m	1.2	1.6	0.9	1.4	JIS C-5012
	Aging	kN/m	1.0	1.3	0.9	1.1	150°C, 7days
Etch Shrinkage	MD	%	0.00	0.04	0.00	(-0.02)	
	TD	%	0.01	0.01	(-0.02)	(-0.04)	
Thermal Shrinkage	MD	%	(-0.05)	(-0.04)	(-0.03)	(-0.02)	250°C, 30min
	TD	%	(-0.05)	(-0.04)	(-0.02)	(-0.02)	
Insulation Resistance		MΩ	9.7×10^7	1.3×10^7	5.1×10^7	1.8×10^7	IPC-TM-650, 2.5.9
Volume Resistivity		MΩ · cm	-	-	1.6×10^6	5.7×10^6	IPC-TM-650, 2.5.17
Dielectric strength		kV/mil	7.5	7.5	7.0	6.5	ASTM-D-149 Short time test
Solder float resistance		°C	400	400	360	360	1 min dipping

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